PROPOSED PLAN FOR THE BUNKER HILL SUPERFUND SITE
Bunker Hill Mine Water Management
Kellogg, Idaho

INTRODUCTION

Acid mine drainage (AMD) from the Bunker Hill Mine poses a significant environmental problem within the Coeur d'Alene River basin of Northern Idaho (Figure 1). An average of 1,500 gallons per minute (gpm) of low pH, metal-rich water flows from the privately owned underground workings. The water presently is treated in a U.S. Environmental Protection Agency (EPA)-owned treatment plant and is discharged to the South Fork of the Coeur d'Alene River (SFCdA). Management of the AMD requires a combination of long-term water treatment plus actions to reduce the quantity of the acid water drainage from the mine.

This Proposed Plan identifies the Preferred Alternative for treating AMD from the Bunker Hill Mine, minimizing the amount of AMD generated by the mine, and disposing of sludge produced during the treatment process. In addition, this Proposed Plan provides the rationale for the Preferred Alternative, summarizes other cleanup alternatives that were more fully evaluated in a Remedial Investigation/Feasibility Study (RI/FS), and proposes an alternative to the wetlands treatment system identified in the 1992 Record of Decision for the non-populated areas of the Bunker Hill Superfund Site (site) (see sidebar on page 3).

This document is issued by EPA and the Idaho Department of Environmental Quality (IDEQ). EPA and IDEQ will select a final remedy after reviewing and considering information submitted during the 30-day public comment period. EPA and IDEQ may modify the Preferred Alternative or select another alternative based on new information or public comments. The public is encouraged to review and comment on all of the alternatives included in this Proposed Plan.

CONTENTS OF THIS PLAN

PUBLIC COMMENT PERIOD

July 11 – August 13, 2001

PUBLIC MEETING

July 31, 2001

6:30 – 9:30 PM
Kellogg Middle School
810 Bunker Avenue

Mine History and Ownership

The Bunker Hill Mine consists of a complex network of about 150 miles of underground tunnels and 6 miles of shafts that extend to more than 1 mile below land surface. Mining was started in 1885 and continued actively into the 1980s. A small-scale mining operation continues currently. At its peak, the Bunker Hill Mine was one of the largest lead/zinc mines in the world. The mine was part of the Bunker Hill Mining Complex (Complex), an integrated mining, milling and smelting operation.

Prior to 1928, liquid and solid waste from the Complex was discharged directly into the SFCdA River and its tributaries. Later, waste was directed to a nearby floodplain where a Central Impoundment Area (CIA) was developed. AMD and wastewater from the Complex was discharged to the CIA where a pond was constructed to settle solids prior to discharging the liquids to the river. This primary treatment mechanism was one of the first major pollution control features instituted by the mining industry. In 1974, a Central Treatment Plant (CTP) was built by the Bunker Hill Mining Company. AMD and Complex waters were stored in an unlined pond

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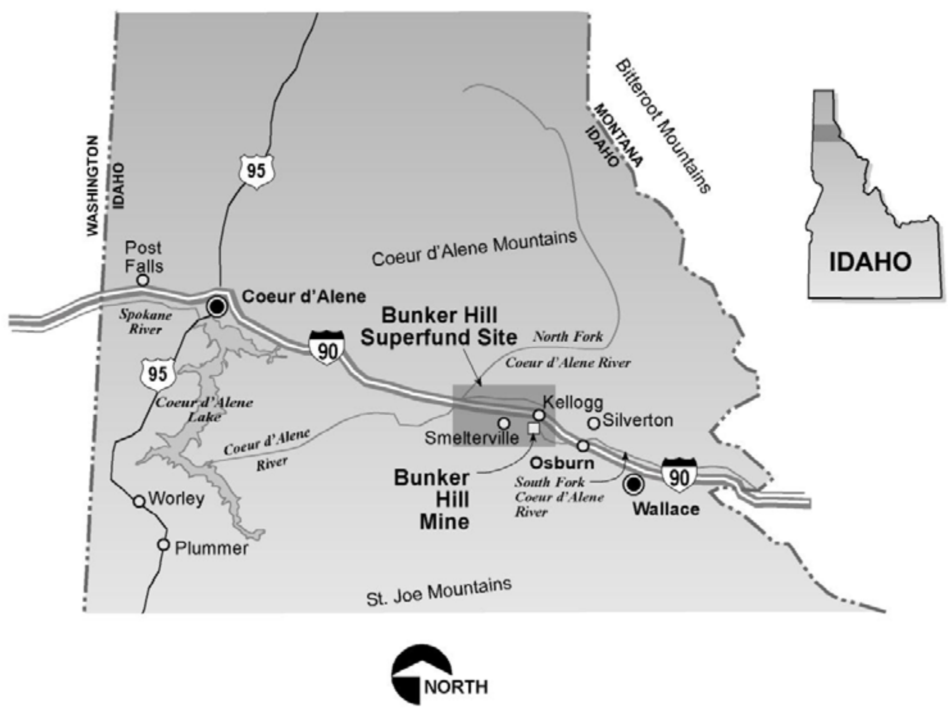

FIGURE 1
VICINITY OF THE BUNKER HILL MINE

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on top of the CIA before being decanted to the CTP. When the smelter closed in 1981, the CIA was no longer required to impound waste water from the Complex, although surface runoff and AMD from the mine were still routed to the CIA prior to treatment at the CTP. Sludge, which formed during the treatment process, was also disposed in unlined ponds on top of the CIA.

Ownership of the mine and surface facilities passed through a number of companies during the more than 100-year history of the site. In early 1991, the Bunker Limited Partnership (BLP), then owner of the Bunker Hill Mine and operator of the CTP, closed the mine and filed for bankruptcy. In late 1991 and 1992, the New Bunker Hill Mining Company (NBHMC), current owner of the Bunker Hill Mine, purchased the underground workings, mineral rights, and much of the land surface above the mine from BLP. The treatment plant, however, was not part of that purchase. BLP, and then the Gulf and Pintlar corporations as creditors of BLP, continued to operate the treatment plant using money from a trust fund established as part of the BLP bankruptcy. The federal and state governments assumed operation of the CTP in November 1994, following the bankruptcy of the Gulf and Pintlar corporations. In that same year, EPA issued a Unilateral Administrative Order to NBHMC directing the company to keep the mine pool pumped to an elevation that would not result in discharges to the SFCdA River, to convey mine water to the CTP for treatment unless an alternative form of treatment was approved, and to provide for emergency mine water storage within the mine. The CTP was operated using the trust fund until February 1996, when it was determined that the trust fund monies would be better used for ongoing site cleanup. Since February 1996 the ongoing treatment of AMD has been conducted and funded by the federal and state governments.

Implementation of the remedy proposed in this plan will involve significant coordination with NBHMC. The role of the NBHMC will be determined prior to remedy implementation. The U.S. Army Corps of Engineers currently operates the CTP. Under the Superfund law, long-term operation of the CTP will be the responsibility of the State of Idaho in the absence of a viable responsible party.

Characteristics of the Bunker Hill Mine Water Management System

The initial development of the Bunker Hill Mine occurred high in the Milo Creek drainage through a number of tunnels. Mine levels were constructed on about 200-foot elevation intervals. About 20 years after the initial development of the mine, the Kellogg Tunnel was constructed on the 9 Level to provide easy access to the upper workings, plus access for making the mine deeper (Figure 2). Mining continued downward with final development of the 31 Level. The lower portion of the mine was allowed to flood as mining activities slowed and then stopped in the 1980s and early 1990s. The pumps in the lower portion of the mine were removed in 1991 and all water was diverted to the lower workings. A program of pumping was initiated in 1994 to maintain the water level at or below the 11 Level of the mine. The mine is currently being worked by the NBHMC on a small scale on levels 9, 10, and 11.

The AMD is a result of acid-forming reactions occurring within the mine among water, oxygen, sulfide minerals (pyrite is the most important), and bacteria. The AMD is acidic (the pH typically measures between 2.6 and 3.8) and contains high levels of dissolved and suspended heavy metals. The constituents of primary concern in the AMD are heavy metals, particularly cadmium, lead, and zinc. Discharge rates from the mine, measured at the Kellogg Tunnel portal, are usually between 1,000 and 2,000 gpm, but have peaked at over 6,000 gpm during precipitation and snow melt.

Within the mine, AMD flows through a complex maze of workings. Water from the upper portion of the mine drains by gravity to the 9 Level or to the lower workings. Water from the lower portion of the mine is pumped to the 9 Level. All of the AMD converges together on the 9 Level of the mine and is drained through the Kellogg Tunnel and out the Kellogg Tunnel portal. About half of the Kellogg Tunnel discharge comes from uncontrolled gravity drainage from the upper workings. The other half is pumped from the lower workings (Figure 3).

At the Kellogg Tunnel portal, the AMD enters a concrete ditch, passes through a flume, and then enters a buried pipeline that conveys it to a lined storage pond. Particles that precipitate from the mine water accumulate in the lined pond, reducing its capacity and necessitating costly cleanout. A pump station is used to pump the stored AMD to the CTP. The CTP uses lime to remove the acidity and to precipitate metals, which settle by gravity and form sludge. The sludge is pumped into an unlined

Bunker Hill Superfund Site

The Bunker Hill facility was placed on the National Priorities List (NPL) in 1983, pursuant to the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), as amended. The Bunker Hill facility includes the area commonly referred to as the Bunker Hill Superfund Site (site). The site encompasses 21-square miles along Interstate 90 in the Silver Valley area of Northern Idaho (see Figure 1). Environmental contamination of surface water, groundwater, soil and sediment occurred at the site as a result of mining, milling, and smelting operations at the Bunker Hill Mining and Metallurgical Complex. The site was divided into two areas in order to focus investigation and cleanup efforts. The populated areas includes residential and commercial properties, right-of-ways (ROWs), and public use areas in the towns of Kellogg, Wardner, Smelterville, Pinehurst, and several unincorporated communities. The non-populated areas of the site include the former industrial complex and mine operations area, river flood plain, hillsides, various creeks and gulches, site surface water and ground water, and the CIA.

A 1991 Record of Decision (ROD) for the populated areas addressed the removal and replacement of lead-contaminated soil from residential and commercial properties, right-of-ways (ROWs), and public use areas. A 1992 ROD for the non-populated areas dealt with the demolition of facilities at the former industrial complex and mine operations area, source removals from various areas including the river flood plain, revegetation of hillsides, clean-out and reconstruction of creeks and gulches, surface capping at several areas including the 200-acre CIA, the construction of landfills for waste consolidated onsite, and surface water and ground water controls and treatment in a wetlands system. Cleanup actions are underway pursuant to both RODs.

In addition, EPA is investigating wide-spread mining-related contamination that exists beyond the 21-square mile area in the broader Coeur d'Alene River Basin (Basin). A Proposed Plan for the Basin project is expected later in 2001.

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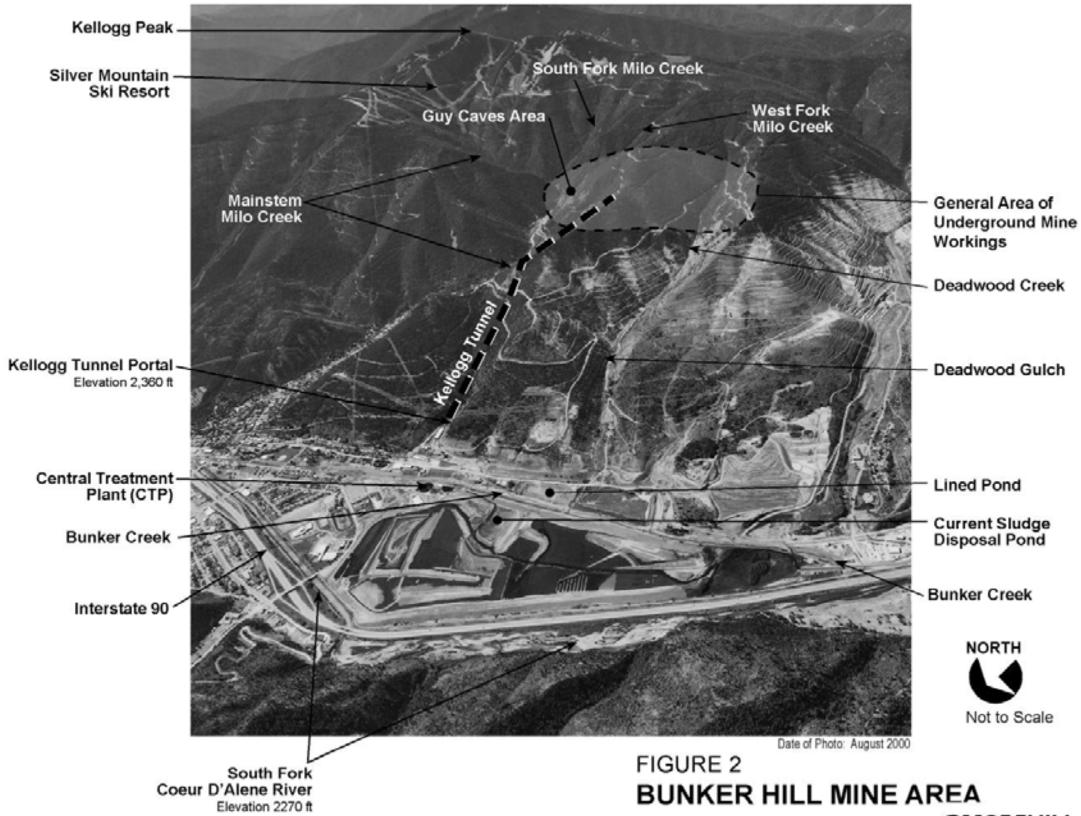

FIGURE 2
BUNKER HILL MINE AREA
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disposal area on top of the CIA. The treated water is discharged into Bunker Creek. Bunker Creek flows westward, paralleling a bike and pedestrian path, then turns northward, passing beneath Interstate 90 where it converges with the SFCdA River (see Figure 2).

The CTP has not been significantly upgraded since it started operations in 1974. The CTP currently treats AMD and other site waters, including discharge from decontamination stations and an old mine water pipeline, landfill leachate, and occasional well development water. The AMD is the focus of the RI/FS and this Proposed Plan because it is the largest and most acidic of all flows treated at the CTP, contains the highest concentrations of dissolved metals, requires the most treatment chemicals, and generates the most sludge.

The AMD from the Bunker Hill Mine results from an annual cycle of recharge from surface streams and precipitation. The land surface overlying the mine workings is within the drainages of Milo Creek and Deadwood Creek (see Figures 2 and 3). Water enters the mine mainly through shallow mine workings, particularly where they underlie one of the streams or a major tributary. Deadwood Creek and all three forks of Milo Creek (mainstem, south fork, and west fork) flow over near-surface workings of the mine.

The West Fork Milo Creek is particularly important with respect to recharge to the mine. Essentially all of the water from this seasonally flowing stream infiltrates directly into the mine above or through the Guy Cave Area, a large surface depression caused by subsidence associated with underground mining. A large portion of this water moves through the pyrite-rich Flood-Stanly Ore Body, which results in the production of the majority of acid water in the Bunker Hill Mine. For example, the discharge from the Flood-Stanly Ore Body represents only about 9 percent of the mine water flow, but carries more than 90 percent of the metal load.

Long-term base flow from the Kellogg Tunnel (1,000 - 1,500 gpm) is a result of groundwater infiltration into rock fractures and faults that release water into the mine on a year-round basis. Short-term seasonal peak flows (1,500 - 6,700 gpm) are caused by rapid stream flow infiltration through near-surface workings. These peak flows are a major cause of maintenance and treatment problems posed by the AMD. Spring snowmelt significantly increases mine water flow and metals load.

The AMD from the Bunker Hill Mine was created as a result of how and where mining activities took place. Underground mining followed veins and ore

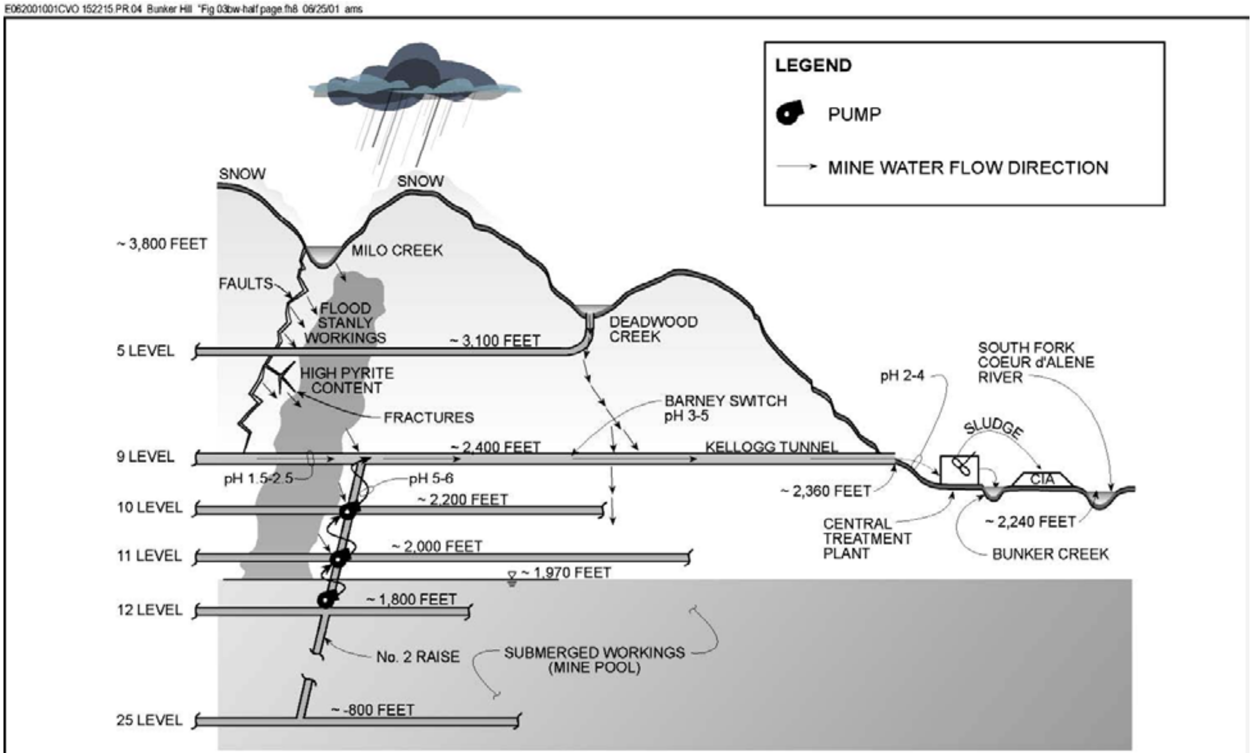

FIGURE 3
GENERAL FLOW MODEL

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bodies that were rich in metals. Some of the ore bodies, particularly the Flood-Stanly, are also rich in pyrite, a major mineral of importance in acid water formation. The mine openings (stopes, raises, chutes, drifts, cross-cuts, winzes, and shafts) allow significantly more water and air movement than in pre-mining conditions. The combination of pyrite, water, and oxygen (air) in the mine workings creates good conditions for acid water formation.

Control of the Bunker Hill Mine AMD depends on reducing the acid water production and/or treating the poor-quality water. AMD problems in other mines, particularly coal mines in the eastern United States, have been controlled by flooding the mine workings with water. The acid water formation is greatly decreased because of the lack of oxygen at the flooded reaction sites. The lower levels of the Bunker Hill Mine (12 Level to 31 Level—bottom 3,500 to 4,000 feet) have been flooded. However, water quality data collected in the 1970s and 1980s showed that most of the acid water production occurs in the upper portion of the mine (above the 9 Level). Flooding the lower workings did little to reduce the AMD problem. Flooding the upper levels of the Bunker Hill Mine is not a practical solution because all of these mining areas are higher in elevation than the floor of the SFCdA River. Plugging the Kellogg Tunnel would result in the formation of acid seeps at numerous locations in the area near the mine. Other alternatives for controlling the acid water production include reducing and/or eliminating the pyrite or the water at the reaction sites. Because the pyrite is disseminated within the mine, with high concentrations in certain ore bodies, particularly the Flood-Stanly, elimination of pyrite also is not a viable alternative. That leaves reducing water inflow to the mine and treatment of the residual AMD as the remaining control approaches.

Decreasing water entry to the underground workings is the most viable way to reduce the magnitude of the AMD problem. A program of reducing recharge within the West Fork Milo Creek drainage was tried by the mining company in the 1960s with some success. A more rigorous program to reduce recharge, particularly to the Flood-Stanly Ore Body, is included within the Proposed Plan.

Complete elimination of the AMD by controlling recharge is not possible at the Bunker Hill Mine. Thus, a water treatment program will be required indefinitely. The key is to make the treatment plant efficient and capable of meeting water quality standards for the SFCdA River. The current CTP is not capable of producing treated water that meets water quality standards. Improvement of the CTP is included within the Proposed Plan.

SCOPE AND ROLE OF THIS PROPOSED PLAN

This Proposed Plan addresses the long-term management of Bunker Hill AMD, including reduction of surface water infiltrating into the mine, treatment of AMD from the Kellogg Tunnel, and long-term sludge disposal. It also proposes an amendment to the section of the 1992 Record of Decision (ROD) that identifies the construction of a wetlands treatment system. The alternative selected in the 1992 non-populated areas ROD indicated that mine drainage would be pretreated at the CTP and discharged to a wetlands system for further treatment. In addition to pretreated AMD, the wetlands system was intended to treat seepage from the CIA, contaminated surface and groundwater from Government Gulch, leachate from the lead and zinc plant closures, and groundwater flowing toward the SFCdA River in the western portion of the Smelterville flats. During studies conducted between 1994 and 1998 by the United States Bureau of Mines, the wetlands treatment system was found to be incapable of meeting the treatment levels established in the ROD. In addition, the ROD recognized the potential development of a total maximum daily load (TMDL) for the SFCdA River as required by the Clean Water Act (see sidebar on TMDL). The ROD noted that final discharge restrictions for the wetlands treatment system would be determined as this process evolved. In August 2000, a final TMDL was issued. The TMDL limits on the amount of cadmium, lead, and zinc that can be discharged by the CTP require even more effective treatment than the levels established in the ROD. This proposed plan describes the preferred alternative to the wetlands system. It is proposed that all site waters currently treated at the CTP, as well as additional site sources identified above if treatment is determined to be necessary, be treated in the upgraded CTP identified in this plan.

SUMMARY OF RISKS

The risk assessment evaluates current and future potential threats to human health and the environment in the absence of AMD treatment. Calculation of carcinogenic and non-carcinogenic risk was not performed as part of this risk assessment. Instead, because the proposed actions focus on controlling AMD discharges to nearby waters, acceptable chemical concentrations were defined using water quality standards. These standards were developed to be protective of aquatic organisms and human health.

Contaminants of Concern

The following have been identified as contaminants of concern. They are commonly found in the AMD in concentrations that exceed water quality standards:

- Aluminum
- Arsenic
- Cadmium
- Copper
- Iron
- Lead
- Mercury
- Manganese
- Selenium
- Thallium
- Silver
- Zinc

Exposure Assessment

Humans, aquatic life, and terrestrial wildlife can be exposed to untreated AMD, treated AMD, and treatment plant sludge. Because of the significantly higher contaminant concentrations in untreated AMD, and the potential for future exposure in the event of CTP failure or shutdown, exposure to untreated AMD in Bunker Creek and the SFCdA River was identified as the primary exposure pathway of concern. Aquatic resources within the downstream water bodies represent the species most sensitive to the contaminants. Terrestrial wildlife and human exposures are also possible if the CTP fails. Current exposure to AMD at locations between the Kellogg Tunnel and the CTP, and to treatment plant sludge, is

What is a TMDL?

A TMDL is a plan developed under the Clean Water Act for implementing water quality improvements in impaired water bodies. A TMDL was issued by IDEQ and EPA in August 2000 for dissolved cadmium, lead and zinc in surface waters of the Coeur d'Alene River Basin (Basin). Large portions of the Basin exceed the water quality standards for these metals. The Basin TMDL establishes allowable pollutant loadings (in pounds per day) from several sources in the South Fork Coeur d'Alene River including the Bunker Hill Central Treatment Plant. The TMDL is an important aspect of the mine water project because it contributes to overall water quality improvements in the Basin.

limited by either controlled access, physical barriers, or safety procedures implemented by workers in the mine yard, CTP, and sludge disposal area. In the event of CTP failure, untreated AMD would discharge into Bunker Creek. Contaminant concentrations in the creek would be similar to raw AMD because of the limited dilution water present much of the year.

Risk Characterization

Metals concentrations in untreated AMD are up to 2,200 times greater than Idaho water quality standards for protection of freshwater aquatic life and human health. If AMD were discharged to Bunker Creek without treatment, the concentration of contaminants in AMD would exceed protective water quality standards. For freshwater aquatic life, exceedances would occur for zinc, cadmium, copper, lead, silver, mercury, arsenic, and selenium. For human health, exceedances would occur for arsenic and thallium. A prolonged direct release of untreated AMD to Bunker Creek and then to the SFCdA River would result in an acutely toxic shock to the aquatic system, resulting in the death of fish and invertebrates.

Humans may be at risk if they have direct contact with or ingest AMD, CTP effluent, or diluted AMD in downstream waters. The risk of AMD exposure is currently limited by controlled access to the mine yard and CTP. In addition, access to AMD in Bunker Creek is currently limited because the area surrounding Bunker Creek has been closed to the public since the mid-1990s. Planned removal of the controlled access in the future, however, will increase the opportunity for exposure. People who consume fish from downstream waters are also potentially at risk, because some of the metals bioaccumulate and bioconcentrate in tissue.

EPA and IDEQ believe that the Preferred Alternative, or one of the other active measures considered in this Proposed Plan, is necessary to protect human health and the environment from actual or threatened releases of untreated AMD. Contaminant concentrations in untreated AMD are significantly greater than in treated AMD. Using zinc as an example, a 1-day release of untreated AMD contains as much zinc as 1.4 years of continuous treated discharge from the existing CTP. Untreated AMD exceeds water quality standards developed to be protective of aquatic organisms and human recreational uses, including fishing, boating, wading, and swimming.

Remedial Action Objectives and Goals

The following are the remedial action objectives:

- Prevent the release of untreated AMD into Bunker Creek and ultimately into the SFCdA River
- Reduce the concentrations and mass per day of metals discharged into Bunker Creek and ultimately into the SFCdA River
- Upgrade the CTP to meet the water quality standards and to improve reliability and efficiency
- Reduce the volume of sludge generated at the CTP and provide long-term sludge disposal capacity
- Reduce the quantity of AMD generated by the mine
- Reduce the long-term AMD management costs

The preliminary remediation goals that apply to the CTP effluent for the contaminants of concern are the Idaho water quality standards, national recommended water quality criteria, and the CTP TMDL limits for cadmium, lead, and zinc.

DEVELOPMENT OF REMEDIAL ALTERNATIVES

The RI/FS document describes the procedures used by a technical team (representatives of EPA, the State of Idaho, and the NBHMC) to develop remedial alternatives. The procedures included:

- Evaluation of the geology and the groundwater of the mine area
- Study of the underground mine water flow paths and AMD chemistry
- Modeling of the relationship between mitigation effectiveness, treatment plant capacity, and storage capacity using historical mine water flow data
- Study of the type of treatment needed to meet water quality standards
- Evaluation of remedial technologies for individual remedy components

The following section provides an overview of the individual components of the remedial alternatives, the technology screening process for each, and the technologies carried forward into alternative development (see Table 1).

AMD Mitigations/Source Control - This component includes actions that could reduce the volume of the AMD. Technologies initially evaluated included surface water diversions, in-mine water diversions, mine flooding, air seals, and capping. All of these options, except infiltration reduction options, were screened from further consideration because of implementability and effectiveness problems. The remaining mitigations are listed in Table 1.

AMD Collection - Two options were considered for collection of AMD within the mine: continue with the current method of gravity collection from the upper workings, pumping from the lower workings,

Table 1
Remedy Components for Alternative Development
Proposed Plan for the Bunker Hill Superfund Site

AMD Mitigations	AMD Collection	AMD Conveyance	AMD Storage	AMD Treatment	Sludge Management
Group A : West Fork Milo Creek diversion Rehabilitate Phil Sheridan raises Plug in-mine drillholes **Group B :** Plug Small Hopes Drift below Mainstem Milo Creek Plug/bypass Inez Shaft below Deadwood Creek **Group C:** Sidehill diversion in West Fork Milo Basin South Fork Milo Creek diversion Bypass Bunker Hill Dam in Mainstem Milo Creek Improve existing diversion in Mainstem Milo Creek Upgrade Phil Sheridan Raise system in West Fork Milo Basin	Continue to use the existing approach, which consists of gravity-draining the combined upper levels water and pumped mine pool water out the Kellogg Tunnel.	Use the existing portal concrete channel and buried pipeline to lined pond. Install tee pipeline for direct flow to CTP.	Surface Storage: Use the existing 7-million-gallon lined pond. In-Mine Storage: Use the existing system, or replace it with new gravity diversions and mine pool pumps.	Update and upgrade the existing lime neutralization HDS treatment plant. Add tri-media filters.	Option A: Sludge disposal beds on CIA that dewater and permanently store the sludge. Option B: Mechanical sludge dewatering and disposal of dry sludge in an offsite landfill. Option C: Disposal of raw sludge in onsite sludge disposal beds located above the smelter closure area. Option D: Sludge drying using sludge drying beds and annual excavation and disposal of dry sludge in an on-site landfill located above the smelter closure area.

The specific effectiveness of each mitigation is unknown.

Group A mitigations are considered most effective for reducing peak AMD flows

Group B mitigations are safety measures for preventing high inflow to near-stream mine workings. While there has been past evidence of infiltration in these areas, data collected during the RI/FS was inconclusive as to the degree of any current infiltration.

Group C mitigations are considered less effective than Group A for reducing peak flows.

and drainage through the Kellogg Tunnel; or divert all upper workings flows to the submerged workings, and pump the submerged workings from wells or a shaft installed from the Deadwood side of the mine to a new pipeline that flows to the treatment plant. The second option was screened from further consideration because of a number of uncertainties associated with the diversion and pumping setup, and the potential for greater costs and higher risk of failure. The existing collection procedures were carried forward into alternative development.

AMD Conveyance - This component includes the conveyance of mine water from the Kellogg Tunnel to the CTP. During the spring of 1999 the AMD conveyance pipeline from the Kellogg Tunnel to the lined pond experienced a decrease in capacity and failed to convey all the mine water. The pipeline was replaced as part of an emergency action. Additional mine water conveyance options are not considered to be necessary. The existing new pipeline is included in each of the remedial alternatives. Each alternative also includes construction of a pipeline segment to bypass the lined pond and directly feed AMD to the CTP.

AMD Storage - AMD storage is required during those times when the treatment plant is shut down for maintenance or repairs, or when the mine water flow exceeds treatment capacity. Three options for AMD storage were evaluated: the existing lined pond, storage in a surface impoundment, and in-mine storage. The existing lined pond has 7 million gallons of storage capacity and would provide about three days of storage at a flow rate of 1,500 gpm. All of the alternatives include use of the existing lined pond. However, as this was determined to be insufficient storage capacity for extended use, additional storage options were considered. Surface impoundment storage was screened out due to space limitations and less favorable comparisons with in-mine storage. In-mine storage is available above the existing mine pool. The mine pool is currently kept at about 30 feet below the 11 Level. The total storage available from 30 feet below 11 Level to the floor of 10 Level is approximately 210 million gallons, which would provide about three months of storage at an average flow rate. This duration is sufficient to accommodate most foreseeable repair and maintenance activities and high peak flow events. All alternatives include in-mine storage. Some alternatives also include a new gravity diversion system to route water from the upper workings into the mine pool for storage, and upgrades to the existing mine pool pumping system to pump diverted water back up from storage.

AMD Treatment - A preliminary technology screening identified various conventional and innovative technologies for mine water treatment. Three technologies were selected for testing that offered the greatest potential to increase the metal removal capability of the existing CTP at the lowest cost: iron co-precipitation, sulfide precipitation, and sulfide functional ion exchange. Laboratory testing showed that sulfide precipitation was preferred. The testing indicated that with filtration and pH adjustments, the lime treatment process at the current plant might sufficiently remove dissolved metals. Pilot-scale testing at the CTP was conducted to assess sulfide precipitation and filters. Two types of filters were evaluated. The test showed that lime treatment with filters significantly reduced suspended solids and total metals concentrations. While it is believed that sulfide precipitation will not be necessary, it could be considered in the future if additional metal removal is desired. Filters will also allow the CTP to be operated in a high-density sludge mode, which will produce sludge estimated to dewater to one-half to one-third of the current volume. Thus, the treatment process carried forward into alternative development is lime neutralization high-density sludge treatment using filters. In addition, old equipment and process controls at the CTP would be upgraded or replaced to increase reliability and efficiency.

Sludge Management - Several sludge disposal and dewatering options were evaluated, including raw sludge disposal in onsite disposal beds or in the mine, and dewatered sludge disposal in onsite disposal beds, offsite landfills, or in the mine. A review of possible areas for sludge disposal onsite resulted in two suitable locations: the southeast end of the CIA near the CTP, or above the smelter closure area. Disposal of raw sludge in the mine was ruled out as no suitable location could be identified. Dewatered sludge disposal in the mine was screened out because of high cost, questionable effectiveness, and implementation difficulties. Two methods to dewater sludge for truck transport were evaluated, which were mechanical dewatering using presses and gravity dewatering using sludge drying beds. The four remaining sludge management options carried into the development of alternatives are summarized in Table 1. Two use raw sludge disposal and two use dry sludge disposal. In addition to the sludge disposal methods discussed above, recovery of zinc and manganese from the sludge was evaluated. Because of many unknowns, this process was screened from further consideration.

IDENTIFICATION OF REMEDIAL ALTERNATIVES

This Proposed Plan presents five alternatives for controlling the mine water. The alternatives are discussed below and summarized in Table 2. Costs for the alternatives are summarized in Table 3. The primary difference among the alternatives is the degree to which AMD mitigations, storage, and treatment capacity are implemented. For example, mitigations are intended to reduce the quantity of AMD discharged from the Kellogg Tunnel. Reducing the discharge will reduce the amount of AMD needing to be stored or treated. Because of these relationships, and the uncertainty associated with mitigation effectiveness, the five alternatives were developed to provide alternative combinations of mitigations, storage capacities, and treatment plant sizes for comparison. The AMD collection, conveyance, and sludge management options (see sidebar) are similar for Alternatives 2 through 5.

Alternative 1 - No Further Action

The No Further Action Alternative forms a baseline against which the others are judged. Consideration of this alternative is required under the Superfund law. For this alternative, no additional activities are undertaken for AMD control, no CTP repairs would be made, and no additional sludge disposal facilities would be constructed when the current CIA disposal area is full, which is expected to occur in 3 to 5 years. At that point the CTP would be shut down because it cannot function without sludge disposal. This would result in untreated AMD being discharged into Bunker Creek and the SFCdA River. When the CTP is shut down, all other mine water management components would also be shut down with the exception of mine water collection within the mine, which would be at the discretion of NBHMC. The cost estimate for Alternative 1 presented in Table 3 only includes 4 years of operations and maintenance (O&M) costs and does not include the costs of environmental damage.

Alternative 2 - Treatment Only

Alternative 2, Treatment Only, consists of an updated and improved treatment plant to reduce the volume of sludge produced and the concentration of metals in the plant discharge. Updates and improvements would include replacing worn equipment, modernizing the control system, adding automatic processes, raising the operational pH to increase removal of dissolved metals, and adding a tri-media filtration system for removal of suspended solids. No actions would be taken to reduce surface water infiltration into the mine or the volume of AMD discharged from the Kellogg Tunnel. The AMD conveyance pipeline from the Kellogg Tunnel would be modified to allow direct flow to the CTP rather than to the lined pond to prevent buildup of precipitates and reduce pumping costs. The treatment plant would be sized to accommodate a peak inflow of 5,000 gpm, large enough to treat all previously recorded Kellogg Tunnel flows except for infrequent high peak flows. High flows greater than 5,000 gpm would be stored either in the existing lined pond, or in the mine pool for later extraction and treatment using the existing equipment. The treatment sludge

Sludge Management Options

The following four sludge management options apply to Alternatives 2 through 5:

Option A: Sludge from the CTP would be pumped into lined sludge disposal beds located on the southeast corner of the CIA near the CTP. In the beds the sludge would dewater by gravity draining and evaporation. The drained water would be collected and re-treated at the CTP. One 10-year-capacity bed (approximately 6 acres) would be constructed at a time and would be capped when its capacity is reached.

Option B: The sludge would be dewatered at the CTP using mechanical equipment and then hauled offsite for disposal in a landfill. Available landfills include Airway Heights, Washington; Roosevelt, Washington; and Arlington, Oregon.

Option C: This option is similar to Option A but the sludge disposal beds would be located near the smelter closure area rather than on the CIA. Sludge would be pumped to the smelter closure area through a pipeline located along McKinley Avenue.

Option D: Sludge from the CTP would be pumped into one of two lined drying beds located on the CIA. These would be smaller than the sludge disposal beds, but would dewater the sludge in the same manner. Use of the beds would alternate yearly. Every year the dried sludge from one bed would be removed and trucked to a sludge landfill located near the smelter closure area.

Table 2
Alternative Summary Descriptions
Proposed Plan for the Bunker Hill Superfund Site

Alternative	Description
1—No Further Action	• No mitigations are constructed • Uses the existing AMD collection, conveyance, storage, treatment, and sludge management systems • CTP is not upgraded or repaired. The CTP is shut down in 3 to 5 years when the existing sludge disposal capacity is exhausted.
2—Treatment Only	• No mitigations are constructed • Uses existing AMD collection, conveyance, and storage systems • Pipeline added for direct flow capability to CTP • CTP upgraded to 5,000 gpm capacity with filters for high-density sludge (HDS) operation, attainment of TMDLs, and compliance with discharge standards. • Alternative 2A uses new CIA sludge disposal beds. Alternative 2B uses mechanical sludge dewatering and offsite disposal. Alternative 2C uses sludge disposal beds located above the smelter closure area. Alternative 2D uses CIA sludge drying beds and annual excavation and disposal in a landfill located above the smelter closure area. Alternatives 2A, 2C, and 2D are estimated to produce about 5,400 y^3/yr of sludge. Alternative 2B is estimated to produce about 10,300 y^3/yr of sludge because the mechanical dewatering is expected to be less efficient than sludge drying beds or sludge disposal beds.
3—Phased Mitigations/Treatment	• Uses a phased implementation and performance evaluation approach for mitigations and CTP sizing. Following initial actions, up to 10 years of monitoring and performance evaluation is used to determine if more mitigations or treatment capacity is needed. • Initially implements the West Fork Milo Creek Diversion, rehabilitates the Phil Sheridan Diversion, and plugs in-mine drill holes, which collectively are expected to reduce peak mine water flows. Total annual volumes are expected to be reduced by about 10 percent by initial mitigations. • Uses existing AMD collection and conveyance with pipeline added for direct flow capability to CTP. • Uses existing lined pond and new gravity diversion system into in-mine storage. Also includes new mine pool extraction pumps. • The initial CTP hydraulic and neutralization capacity is 5,000 gpm. The initial filtration capacity is 2,500 gpm. Lime consumption is expected to be reduced 10 percent by initial mitigations. • Uses one of the four sludge disposal options described for Alternative 2. The sludge volume is expected to be initially 10 percent less than Alternative 2 because of the mitigation-induced AMD volume reduction.
4—Phased Mitigations/Treatment with Plugging of Near-Stream Workings	• Similar to Alternative 3, except plugs are initially placed in the Small Hopes drift below Mainstem Milo Creek, and in the Inez Shaft below Deadwood Creek. These will reduce or eliminate the potential for stream erosion into the underlying mine workings. These two mitigations would be implemented under Alternative 3 if needed, based on the monitoring program and the phased approach.
5—Treatment with All Mitigations	• Similar to Alternatives 3 and 4, except a phased approach is not used. All mitigations are implemented initially, and the CTP is sized at 2,500 gpm with no potential phased expansion. Mitigation performance monitoring is conducted for 5 years, then stopped.

Table 3
Summary of Costs
Proposed Plan for the Bunker Hill Superfund Site

Alternative	Capital Costs (million $)	Annual O&M Costs[1] (million $)	30-Yr NPV[2] O&M Costs (million $)	30-Yr NPV[2] Total Costs (million $)
Alternative 1—No Further Action (4-year NPV)				
1—No Further Action	0	1.88 (Yrs 1-4)	6.4	6.4
Alternative 2—Treatment Only				
2A—with CIA Sludge Disposal Beds	16.6	2.21 (Yrs 1-30)	27.4	44.0
2B—with Mechanical Sludge Dewatering and Offsite Disposal	15.5	2.90 (Yrs 1-30)	36.0	51.5
2C—with Smelter Closure Area Sludge Disposal Beds	21.2	2.23 (Yrs 1-30)	27.7	48.8
2D—with CIA Sludge Drying Beds and Smelter Closure Area Sludge Landfill	20.1	2.31 (Yrs 1-30)	28.7	48.8
Alternative 3—Phased Mitigations/Treatment				
3A—with CIA Sludge Disposal Beds (the Preferred Alternative)	22.0	2.57 (Yrs 1-10) 2.33 (Yrs 11-30)	30.6	52.6
3B—with Mechanical Sludge Dewatering and Offsite Disposal	20.8	3.21 (Yrs 1-10) 2.97 (Yrs 11-30)	38.6	59.4
3C—with Smelter Closure Area Sludge Disposal Beds	26.4	2.60 (Yrs 1-10) 2.36 (Yrs 11-30)	30.9	57.3
3D—with CIA Sludge Drying Beds and Smelter Closure Area Sludge Landfill	25.0	2.67 (Yrs 1-10) 2.43 (Yrs 11-30)	31.8	56.8
Alternative 4—Phased Mitigations/Treatment with Plugging of Near-Stream Workings				
4A—with CIA Sludge Disposal Beds	23.0	2.57 (Yrs 1-10) 2.33 (Yrs 11-30)	30.6	53.6
4B—with Mechanical Sludge Dewatering and Offsite Disposal	21.8	3.21 (Yrs 1-10) 2.97 (Yrs 11-30)	38.6	60.4
4C—with Smelter Closure Area Sludge Disposal Beds	27.4	2.60 (Yrs 1-10) 2.36 (Yrs 11-30)	30.9	58.3
4D—with CIA Sludge Drying Beds and Smelter Closure Area Sludge Landfill	26.0	2.67 (Yrs 1-10) 2.43 (Yrs 11-30)	31.9	57.9
Alternative 5—Treatment with All Mitigations				
5A—with CIA Sludge Disposal Beds	28.8	2.70 (Yrs 1-5) 2.46 (Yrs 6-30)	31.5	60.3
5B—with Mechanical Sludge Dewatering and Offsite Disposal	27.6	3.28 (Yrs 1-5) 3.04 (Yrs 6-30)	38.7	66.4
5C—with Smelter Closure Area Sludge Disposal Beds	33.2	2.73 (Yrs 1-5) 2.48 (Yrs 6-30)	31.8	65.0
5D—with CIA Sludge Drying Beds and Smelter Closure Area Sludge Landfill	31.4	2.79 (Yrs 1-5) 2.55 (Yrs 6-30)	32.6	64.0

[1]The annual O&M costs for Alternatives 3 and 4 is higher the first ten years due to the mitigation performance monitoring assumed to be conducted the first ten years as part of the phased approach. Alternative 5 assumes only 5 years of mitigation performance monitoring.

[2]The 30-yr Net present Value (NPV) costs are calculated using a 7 percent interest rate.

would be managed using one of four sludge disposal options common to all alternatives (see sidebar on sludge management options). Performance monitoring would be conducted over the life of the remedy to assess untreated AMD at the Kellogg Tunnel and treated AMD discharged to Bunker Creek. Construction of the remedial components would take up to 3 years.

Alternative 3 - Phased Mitigations/Treatment

Alternative 3, the Preferred Alternative, would phase the implementation of actions to reduce surface water infiltrating the mine. The phased approach would allow mitigation effectiveness to be assessed. The treatment plant would be the same type as for Alternative 2, but would have an initial capacity of 2,500 gpm rather than 5,000 gpm. This size of treatment capacity may be sufficient if the mitigations can significantly reduce peak mine water flows. The initial mitigations to reduce AMD flows from the Kellogg Tunnel would be construction of the West Fork Milo Creek Diversion, rehabilitation of the now defunct Phil Sheridan Diversion, and plugging of in-mine drill holes (Group A of Table 1). Performance data would be evaluated annually for a period of up to 10 years to determine the effectiveness of these initial measures. Additional mitigation measures and/or treatment plant capacity would be constructed based on the performance and cost-effectiveness of the initially installed measures. If mine water flows occurred that exceed 2,500 gpm, the excess would be stored temporarily in the lined pond or in the mine using a new gravity diversion system into the mine pool. A new mine pool extraction system would be installed to reduce the time needed to extract the stored water and to increase reliability. The AMD conveyance pipeline from the Kellogg Tunnel would be modified to allow direct flow to the CTP rather than to the lined pond. Sludge would be disposed using one of the four sludge disposal options. Performance monitoring would be conducted over the life of the remedy to assess untreated AMD at the Kellogg Tunnel and treated AMD discharged to Bunker Creek. All remedy components, including the initial mitigations and treatment plant upgrades, would take up to three years to construct. Surface and in-mine monitoring to determine if additional mitigations or treatment plant capacity is needed would occur for up to 10 years.

Alternative 4 - Phased Mitigations/ Treatment and Plugging of Near-Stream Workings

All components of Alternative 4 are the same as Alternative 3, except that it includes two additional initial mitigation measures. These measures are plugging the Small Hopes Drift on Mainstem Milo Creek, and plugging the Inez Shaft in Deadwood Gulch (Group B of Table 1). These additional measures would reduce or eliminate the possibility of high stream flows eroding direct flow paths into the mine. These measures would also be constructed in Alternative 3 if determined to be necessary during the performance evaluations. Thus, the only difference between Alternatives 3 and 4 is the starting point of how many mitigations are initially constructed. Alternative 4 uses the same phased approach as Alternative 3 for monitoring performance and determining the need for additional actions. All remedy components, including the initial mitigations and treatment plant upgrades, would take up to three years to construct. Surface and in-mine monitoring to determine if additional mitigations or treatment plant capacity is needed would occur for up to 10 years.

Alternative 5 - Treatment with All Mitigations

Unlike Alternatives 3 and 4, Alternative 5 does not use a phased approach. It consists of implementing all the flow reduction measures identified for Alternative 4 plus the others shown in Table 1 under AMD Mitigations (Group C), and construction of a treatment plant having a capacity of 2,500 gpm. Given the extensive use of flow reduction measures, additional treatment capacity is not expected to be necessary. The other components are similar to Alternatives 3 and 4, except monitoring of flow reduction measures is assumed to occur for up to 5 years rather than 10 to assess mitigation performance. Additional mitigation monitoring would not be required because no further flow reduction measures would be implemented. Monitoring of untreated AMD at the Kellogg Tunnel and treated AMD discharged to Bunker Creek would continue for the life of the remedy as in Alternative 2. Construction of the remedy components would take up to 3 years.

EVALUATION OF ALTERNATIVES

Federal law requires that alternatives be evaluated using nine criteria (see sidebar on Evaluation Criteria). These criteria are grouped into three categories. The following sections discuss the alternatives with respect to the nine criteria.

Evaluation Criteria

THRESHOLD CRITERIA

These two criteria must be met by the chosen alternative.

- ***Overall Protection of Human Health and the Environment*** addresses whether or not adequate protection of health and the environment is provided during and after construction of the remedy.
- ***Compliance with Applicable or Relevant and Appropriate Requirements*** addresses whether or not the alternative would meet requirements of federal and state laws and regulations that apply or that are relevant and appropriate to the actions.

BALANCING CRITERIA

These criteria are the primary factors that are taken into account in comparing the alternatives and choosing the preferred alternative.

- ***Long-term Effectiveness and Permanence*** refers to the ability of the alternative to reliably protect human health and the environment over time once the cleanup actions have been implemented.
- ***Reduction of Toxicity, Mobility, or Volume through Treatment*** addresses the expected performance of treatment technologies that may be used and whether treatment is a main element of the proposed actions.
- ***Short-term Effectiveness*** evaluates the potential to adversely affect human health and the environment during the time when cleanup actions are taking place, and how quickly the alternative achieves protection of human health and the environment.
- ***Implementability*** refers to the technical and administrative difficulties for carrying out the alternative, including the availability of special materials or services, the need for regulatory approvals, and how hard it would be to construct and operate a particular remedy at this site.
- ***Cost*** is an estimate of the construction costs plus the operating and maintenance costs of the alternative.

MODIFYING CRITERIA

These two criteria involve consideration of state and public concerns that may modify the alternative picked for the site.

State Acceptance refers to whether the alternative addresses the concerns of the state.

- ***Community Acceptance*** pertains to whether or not the alternative adequately addresses the concerns of the local community.

Overall Protection of Human Health and the Environment

Alternative 1 does not protect human health and the environment. It results in the direct discharge of untreated AMD to Bunker Creek, which could endanger humans and result in toxic conditions for aquatic life. Alternatives 2 through 5 all use the same treatment technology. They protect human health and the environment by removing the toxicity associated with AMD to levels that achieve the water quality standards or TMDL limits for contaminants of concern. Alternatives 3, 4, and 5, however, are more protective than Alternative 2. They include measures to reduce the overall volume of AMD, and upgraded diversion and pumping systems that permit more significant in-mine water storage. These additional components reduce the chance of high mine water flows exceeding the downstream capacity of the treatment plant and resulting in a release of untreated AMD to Bunker Creek.

All four sludge options are expected to be protective of the community and the environment. Options A, C, and D, the onsite sludge disposal options, provide protection by using lined disposal facilities to prevent leakage to the environment. Fencing and gates would also be used to prevent public exposure to sludge. Option A, disposal in sludge beds located on the CIA, may provide somewhat higher worker protection because sludge handling is minimized. Option B, offsite disposal, provides protection by removing the sludge from the community and transporting it to a secure facility.

Compliance with Applicable or Relevant and Appropriate Requirements

The principal environmental regulations associated with water treatment and sludge disposal for all of the alternatives include the Idaho Water Quality Standards, National Recommended Water Quality Criteria, National Pollutant Discharge Elimination System (NPDES), the Bevill Amendment to the Resource Conservation and Recovery Act (RCRA), RCRA Subtitle D regulations for solid waste disposal facilities, and Idaho solid waste management rules.

Alternative 1, the No Further Action Alternative, would not comply with requirements of environmental regulations and takes no measures to prevent potential future risks. This alternative results in release of untreated AMD to Bunker Creek.

Because it does not comply with regulatory requirements and would not protect human health and the environment, this alternative is not considered further nor discussed under the remaining criteria. All other alternatives and sludge management options are expected to achieve water quality standards and comply with regulatory requirements.

Long-Term Effectiveness and Permanence

None of the alternatives will halt the acid-producing reactions occurring within the mine. Acid production and metals release is expected to continue for hundreds or thousands of years unless new technology becomes available and is used to stop the process. The alternatives, however, differ in the degree to which they reduce the quantity of AMD and the magnitude of residual risk remaining from treatment plant sludge.

Alternative 2 does not reduce the long-term release of AMD from the mine, but uses improved and larger treatment systems to protect human health and the environment by improving the quality of the discharge. Alternatives 3, 4, and 5 use measures to reduce both peak and average AMD flows, which reduces the long-term risk from large flows exceeding treatment capacity compared to Alternative 2. Therefore, these alternatives provide the greatest degree of long-term effectiveness and permanence. The specific effectiveness of the AMD reduction measures (mitigations) will not be known until they are constructed and operated for some time.

Alternatives 2 through 5 all require long-term operation, maintenance, and periodic replacement of components. AMD collection within the mine is the same for all alternatives. Continual and substantial effort is needed to keep the workings maintained to ensure unimpeded movement of AMD either into storage or out through the Kellogg Tunnel. The in-mine gravity storage system used in Alternatives 3, 4, and 5 will be more reliable than the pumped system of Alternative 2 because it does not rely on electricity to operate. Alternatives 2 through 5 all use the same treatment processes, which are expected to provide long-term protection by reducing the acid and metals to safe levels. The treatment plant is expected to be reliable and have reasonable backup systems.

Alternatives 2 through 5 all produce the same type of sludge. Compared to Alternative 2, Alternatives 3, 4, and 5 are expected to reduce long-term sludge volumes. These reductions reduce the amount of on- or offsite land required for long-term disposal, and the magnitude of residual risk remaining from the sludge. All four sludge management options are expected to have adequate and reliable controls to prevent migration of contaminants and resulting public exposure. Option B (offsite disposal) is expected to produce nearly twice the sludge volumes as the other options because mechanical dewatering is not expected to be as thorough as gravity dewatering and evaporation. Sufficient sludge disposal space is available onsite for Options A, C, and D, or regionally for Option B. Long-term land use restrictions will be needed for the onsite options (A, C, and D) to prevent disturbance of the capped and closed sludge disposal areas. Option D requires use of trucks to transport the dried sludge from the CIA drying beds to the smelter closure area landfill. About 300 to 600 truckloads would be required over a 1-month period every fall. This volume of truck traffic along McKinley Avenue will provide some community disruption.

Reduction of Toxicity, Mobility, or Volume Through Treatment

Alternatives 2 through 5 all use the same treatment process. The same treatment plant effluent quality is expected from each alternative. Alternative 2, however, does not employ actions to reduce the quantity of AMD generated and volume of sludge produced. Alternatives 3 and 4 are expected to produce about 10 percent less AMD and sludge than Alternative 2, and Alternative 5 is expected to produce 20 percent less AMD and sludge than Alternative 2.

The onsite sludge disposal options (A, C, and D) use low-permeability liner and cover systems to isolate the sludge from the environment. The offsite option will use appropriate disposal facilities to ensure that the sludge is properly managed.

Short-Term Effectiveness

Alternatives 2 through 5 provide similar levels of short-term protectiveness. The AMD will continue to be collected, stored, and treated using existing systems during construction of new systems. Impacts on the community during construction of Alternatives 2 through 5 are expected to be similar because they all involve AMD pipeline and CTP upgrades, and possibly construction of onsite sludge disposal facilities. Worker safety is also expected to be about the same because each uses similar construction practices.

Environmental impacts associated with Alternatives 3, 4, and 5 are greater than Alternative 2 because of impacts from construction of flow reduction measures. Some of these measures require work in stream segments, although some of the segments have been previously disturbed by past mining activities. Actions will be taken to minimize these impacts.

Alternatives 2 through 5 will provide protection as soon as they are implemented. The implementation time is similar for each. The phased approach used for Alternatives 3 and 4 may take up to 10 years to complete, but initially implemented remedial actions are expected to provide protection from untreated releases of AMD during the phasing period.

The onsite sludge options (A, C, and D) are expected to have about the same construction impacts on the community because they require similar construction methods and timeframes. Option B, the offsite option, will have minimal community construction impacts because all construction occurs at the CTP.

Implementability

Alternatives 2 through 5 all have similar implementability. All use standard technologies expected to be reliable given proper operation and maintenance, and all require materials and services available locally or regionally. None of the alternatives prevent the undertaking of additional remedial actions, if necessary. Alternatives 2 through 5 all have the same administrative feasibility, which requires agency coordination similar to that already conducted for other portions of the site. Alternatives 3, 4, and 5 require coordination with landowners to implement AMD reduction measures.

Alternatives 2 through 5 require coordination with the mine owner for AMD collection and implementation of in-mine storage. Alternatives 3, 4, and 5 require in-mine monitoring to assess the effectiveness of the AMD reduction measures. In-mine monitoring is technically feasible and requires the cooperation of the mine owner for access to underground monitoring locations. In-mine monitoring is not required for Alternative 2.

Onsite sludge options (A, C, and D) would be constructed on federally owned land and would use standard technologies. Therefore, there are no administrative impediments to locating sludge disposal beds in these areas. These areas are also currently under industrial use (waste containment/disposal) and they are anticipated to remain so in the future. Option A, which would be located on top of the CIA, would not preclude community redevelopment of the CIA in the future because the sludge disposal beds would occupy only a limited portion of the CIA (about 10 percent over 30 years), and would be covered and capped when full. Option C will be more difficult to implement than options A and D because of the required sludge pump station and pipeline along McKinley Avenue. Reliance on the pump station and pipeline may make Option C less reliable than options A or D. Option D requires use of public roadways to transport the sludge from the CIA drying beds to the smelter closure area landfill. There is sufficient regionally available offsite sludge disposal capacity for Option B.

Cost

Table 3 presents estimates of the capital, annual operations and maintenance (O&M), and 30-year net present value costs for the alternatives. The 30-year basis is selected merely to compare the early costs of the alternatives. Alternatives 2 through 5 are all expected to have costs beyond 30 years because present information suggests that the AMD will continue indefinitely.

The 30-year net present value costs range from $44.0 million for Alternative 2A to $66.4 million for Alternative 5B. Alternatives 3 and 4 are in the middle of the cost range. Alternative 2 is the least costly, and Alternatives 3, 4, and 5, which all use flow reduction measures, are more costly. Total costs and annual O&M costs go up as more of these measures are implemented.

Of the four sludge options, Option B, which uses mechanical dewatering and offsite disposal, is the most costly. Option A, which uses CIA sludge drying beds, is the least costly. Options C and D have about the same cost.

State Acceptance

The State of Idaho has participated with EPA over the past 2 years in site investigations and analyses, is in agreement with the identified alternatives, and supports the preferred alternative for managing AMD and other site water. Issues of concern and goals expressed by the state during the development of the RI/FS and the Proposed Plan include: maximizing the extent of developable land within the site; maximizing the reduction in the quantity of AMD and sludge through source control measures; and minimizing the costs of long-term operations and maintenance that would eventually be borne by the state or a private party.

In addition, EPA and IDEQ have discussed the results of the RI/FS with the federal natural resource trustees, including the U.S. Department of Interior (DOI), U.S. Department of Agriculture, and the Coeur d'Alene Tribe of Idaho. EPA has also coordinated with DOI on the identification of threatened and endangered species within the project area potentially affected by the alternatives. The trustees have expressed the following issues of concern: the need to coordinate site actions with the Basin project; the impacts of current and future CIA sludge disposal on seepage from the CIA; minimizing mitigation construction impacts on wildlife habitat; the need for close coordination between EPA, IDEQ, and the mine owner; and achievement of the TMDL at the CTP as an important part of improving overall water quality in the Basin.

Community Acceptance

Community comments on all alternatives will be evaluated after the public comment period ends and will be described in a Record of Decision amendment. EPA and IDEQ met with the Bunker Hill Task Force in February to discuss the RI/FS results. The Bunker Hill Task Force, a community organization formed in 1985 and still active today, serves as the liaison between EPA/state and the community. Also, the Task Force reviewed and commented on a draft copy of this Proposed Plan. The Task Force identified the following issues of concern: a desire to preserve developable site land to the maximum extent possible; concerns regarding the potential for recontamination from sludge disposal areas or uncontrolled releases of untreated AMD to Bunker Creek; a desire to keep the mine in operation; support for decreasing O&M costs as much as possible; the need to coordinate the disposal efforts of various projects that are competing for scarce, local disposal capacity; the need for close coordination with the mine owner; and comments about the overall costs for the project.

The NBHMC has not yet expressed a preference for any particular alternative. The company has, however, indicated its intention to continue mining, to rebuild the mine's infrastructure, seek investors interested in joint mining ventures, and its desire to minimize the impact that mine water control measures have on ongoing mining operations.

THE PREFERRED ALTERNATIVE

The Preferred Alternative for managing AMD from the Bunker Hill Mine is Alternative 3 - Phased Mitigations/Treatment using sludge disposal Option A with the modifications described below. The major components of the Preferred Alternative are described below. Several of these components, including AMD collection, AMD conveyance, and sludge management, are similar for all alternatives except Alternative 1.

AMD Mitigations - Construct the West Fork Milo Creek Diversion, rehabilitate the Phil Sheridan Raise, and plug in-mine drill holes. These efforts are likely to have the greatest impact on reducing the flow of mine water from the Kellogg Tunnel. Other flow reduction measures will be considered in the future based on performance monitoring and an evaluation of the ability of additional measures to provide cost-effective water reductions.

AMD Collection - The existing collection system would be used to collect water within the mine and transport it to the Kellogg Tunnel.

AMD Storage - Mine water flows in excess of 2,500 gpm would be temporarily stored in the existing lined pond or in the mine using a new gravity diversion system into the mine pool. A new mine pool extraction system would be installed to reduce the time needed to extract the stored water and to increase reliability.

AMD Conveyance - A new section of pipe would be added to the existing pipeline, which extends from the Kellogg Tunnel to the lined pond, in order to allow direct flow of AMD to the CTP rather than to the lined pond.

AMD Treatment - The treatment plant would be upgraded to improve efficiency and increase reliability, to make less sludge, and to achieve lower concentrations of metals in the plant discharge. It would have an initial treatment capacity of 2,500 gpm. Additional capacity could be added in the future if determined to be necessary.

Sludge Management - EPA and IDEQ prefer sludge disposal Option A. However, given concerns about competing disposal needs, preserving developable site land, and the potential development of regional disposal areas in the future as part of the Basin cleanup efforts, EPA and IDEQ propose to implement sludge disposal in the following manner: 1) Implement initial upgrades to the CTP. These upgrades will reduce the current amount of sludge produced by about half, thereby doubling the expected life of the current disposal area; 2) When additional sludge disposal capacity is needed, reevaluate whether additional regional disposal capacity has become available as part of the Basin cleanup efforts that would make offsite disposal more cost-effective. If so, pursue offsite sludge disposal. If not, construct one 10-year disposal bed on the CIA; 3) Step 2 would be reconsidered prior to the construction of additional sludge beds on the CIA.

Summary

Alternative 3, the Preferred Alternative, was selected over other alternatives for the following reasons:

- It employs the most promising flow reduction measures to reduce the overall volume of AMD generated by the mine and reduces peak and average AMD flows. These efforts reduce the long-term risk from large flows exceeding collection, storage, conveyance, or treatment plant capacity and discharging untreated AMD into Bunker Creek and the SFCdA River.
- It reduces the volume of sludge produced as part of the treatment process and the amount of land required for long-term disposal.
- It includes upgraded diversion and pumping systems that permit more reliable and significant in-mine storage, thus reducing the long-term risk from large flows exceeding treatment or storage capacity.
- While the specific effectiveness of all the flow reduction measures (mitigations) is unknown, Alternative 3 includes actions with the best chance of reducing peak AMD flows from the Kellogg Tunnel, and a phased approach to implementing additional flow reduction measures and treatment plant sizing. This phased approach allows careful consideration of the most cost-effective ways to reduce mine water flow and optimize treatment plant size, and provides flexibility to benefit from new information gained during installation and operation of initial flow reduction efforts and treatment capacity.
- Because of the uncertainty associated with mitigation effectiveness, the additional mitigations of Alternatives 4 and 5 may not be appreciably more effective than those of Alternative 3. The phased approach will provide information to reduce the uncertainty.
- Alternative 3 includes monitoring of surface streams, groundwater levels, and in-mine flows to help identify other potential water reduction approaches.
- The flow reduction efforts prevent clean water from becoming contaminated and reduce the amount of treated water and metals discharged from the treatment plant. This reduces the metal load to Bunker Creek and the SFCdA River.
- Sludge disposal Option A minimizes sludge handling and community disruption. The periodic reevaluation of other sludge disposal areas will address community concerns regarding preserving developable site land to the maximum extent possible, will provide a means for coordination regarding other site and Basin disposal needs, and will maximize the opportunities for offsite sludge disposal.
- Compared to Alternative 2 (Treatment Only), the capital and O&M costs for Alternative 3 (Phased Mitigations/Treatment) are higher. These increased costs result primarily from several additional remedy components associated with Alternative 3 that are not included in Alternative 2, including the flow reduction measures, costs associated with the temporary monitoring program to assess the effectiveness of these measures, and the more effective in-mine storage system. EPA and IDEQ believe that these efforts provide safeguards that are commensurate with their increased costs. The capital and O&M costs associated with several other remedy components including treatment and sludge management are actually lower for Alternative 3 compared to Alternative 2. This is a result of reductions in the amount of AMD generated, sludge produced, and lime used at the CTP that are expected under Alternative 3.

Based on the information currently available, the Preferred Alternative meets the threshold criteria and provides the best balance of tradeoffs among the other alternatives with respect to the evaluation criteria. EPA expects the preferred alternative to satisfy the following statutory requirements in CERCLA section 121(b): (1) be protective of human health and the environment; (2) comply with ARARs; (3) be cost-effective; (4) use permanent solutions; and (5) satisfy the preference for treatment as a principal element.

COMMUNITY PARTICIPATION

Public participation is an important part of the remedy selection and decision making process. Local knowledge and the needs and desires of the local community play a part in deciding what cleanup actions are appropriate. EPA is also required to conduct public participation under Section 300.403(f)(2) of the NCP.

This Proposed Plan is an end result of a very detailed RI/FS completed in April 2001. The Proposed Plan, RI/FS, and other related reports and documents are contained in the Administrative Record file for this action (see below for location). The public is encouraged to review these documents to gain a better understanding of the proposed actions. Comments are welcomed on the Proposed Plan and the RI/FS.

A 30-day public comment period has been established from July 11 to August 13, 2001. During this time, EPA and IDEQ will accept written and verbal comments. The attached sheet can be used for written comments. The final decision will incorporate changes based on the comments received. A written response to comments called a Responsiveness Summary will be prepared and made a part of the Administrative Record. During the comment period, direct your comments to:

Mary Kay Voytilla, EPA Project Manager
USEPA Region 10
1200 Sixth Avenue, ECL-113
Seattle, Washington 98101
Phone: (206) 553-2712 direct or toll free at 1-800-424-4EPA
Email: voytilla.marykay@epa.gov

EPA is hosting a public meeting on July 31, 2001, from 6:30 to 9:30 PM at the Kellogg Middle School at 810 Bunker Avenue. At this meeting EPA will present information from the RI/FS, answer questions, and provide an opportunity for you to make comments in person.

How to Get More Information

To request a copy of the Proposed Plan call Judy Smith, EPA Community Relations Coordinator, at (206) 553-6246 direct or toll free at 1-800-424-4EPA, or Email Smith.JudyR@epa.gov. The Proposed Plan and RI/FS are also available on EPA's web site at www.epa.gov/r10earth; click on the index and select "B" for Bunker Hill. The Administrative Record file is available for your review at the following locations:

Kellogg Public Library
16 West Market Avenue
Kellogg, Idaho 83837

EPA Superfund Record Center
1200 Sixth Avenue
Seattle, Washington 98101

Glossary

AMD	acid mine drainage
BLP	Bunker Limited Partnership
CIA	Central Impoundment Area
CTP	Central Treatment Plant
EPA	U.S. Environmental Protection Agency
Flume	A device for measuring water flows
gpm	gallons per minute
IDEQ	Idaho Department of Environmental Quality
Metal	Dissolved or suspended metal complex
NBHMC	New Bunker Hill Mining Company
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPDES	National Pollutant Discharge Elimination System
O&M	operation and maintenance
Portal	The surface opening of a tunnel
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
SFCdA	South Fork Coeur d'Alene (River)
Workings	Mine excavation or operating areas

BUNKER HILL MINE WATER MANAGEMENT PROPOSED PLAN

Comment Sheet

Place
Stamp
Here

MARY KAY VOYTILLA
PROJECT MANAGER
EPA REGION 10
1200 SIXTH AVENUE, ECL-113
SEATTLE, WA 98101

Use this space to write your comments

Your opinions on the recommended plan for the Bunker Hill Mine Water Proposed Plan are important to EPA. Comments provided by the public are valuable in helping EPA select a final remedy for the site.

You may use the space below to write your comments, then fold, add postage, and mail. Comments must be postmarked by August 13, 2001.

Name:

Address:

City:

State: Zip: